

Hydraulic conductivity of tuff

S.N. Davis: Porosity and Permeability of Natural Materials, in *Flow Through Porous Media*, R.J.M. De Wiest (ed.), Academic Press, New York, 1969, pages 64-65.

3. Volcanic Rocks

3.1. INTRODUCTION

Rocks that have originated from the solidification of a magma at or near the surface of the earth are classified as volcanic rocks. This definition not only includes the solidified material in ancient lava flows, but also rocks within sills, dikes, and other near-surface intrusions as well as a great variety of material that was originally fragmental ejecta from volcanic eruptions. Hydraulic properties of these rocks vary from those of dense fractured rocks to nonindurated fragmental material which is almost identical to alluvium. Typical values of permeability and porosity are given in Table 3.

Although, when viewed on a microscopic scale, volcanic rocks may be almost entirely made of interlocking crystals, they possess several distinctive hydrologic characteristics that set them apart from the normal crystalline rocks which have just been discussed. The solid matrix of volcanic rock is probably less permeable than the average granite, gabbro, or slate, but unlike these rocks, a number of primary features give rise to permeable zones within the otherwise solid rock. These features are related to the final history of the rocks and only indirectly to the chemical characteristics of the rocks. For this reason, considerable attention will be given to details of genesis.

TABLE 3
Porosity and Permeability of Volcanic Rocks

Rock name	Porosity (%)	Permeability (darcys)	Reference
Basalt			
very dense	0.80 ^a	—	Schoeller (1962)
porous	11.4	—	Schoeller (1962)
moderately dense	7.7 ^b	1.4×10^{-5}	
Obsidian	0.52	—	Schoeller (1962)
Phonolite	1.98 ^c	—	Schoeller (1962)
Pumice	87.3	—	Schoeller (1962)
Tuff	31.0 ^a	—	Schoeller (1962)
zeolitized	39 ^d	4×10^{-5}	Keller (1960)
pumiceous	40 ^d	1.15×10^{-2}	Keller (1960)
friable	36 ^d	1.4×10^{-3}	Keller (1960)
welded	14 ^d	3.3×10^{-4}	Keller (1960)

^a Average of 8 samples.

^b Unpublished test results, K. Shizaki (1966), Univ. of Hawaii, Honolulu.

^c Average of 5 samples.

^d Porosity and permeability are averages of several samples.